



Program Progress Performance Report for University Transportation Centers

Prepared for the USDOT Research and Innovative Technology Administration (RITA)

Project title: **Pacific Northwest Transportation Consortium (PacTrans): Using Technological Advances to Develop Data-driven, Sustainable Solutions for the Diverse Transportation Needs of the Pacific Northwest**

RITA Sponsor Award Number: DTRT12-G-UTC10

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Report #6, PPPR reporting on six months (July 1, 2014 – December 31, 2014)

1. Accomplishments

- **What are the major goals and objectives of the program?**

PacTrans focuses on using technological advances to develop data-driven, sustainable solutions for the diverse transportation needs of the Pacific Northwest. Major goals and objectives of PacTrans include: serving as Region 10's research engine, applied technology showcase, workforce development base, educational leader, information center, and collaboration platform.

- **What was accomplished under these goals?**

During the six month period (from July 1 – December 31, 2014), our major activities followed our implementation plan and aimed at ensuring our region's transportation expertise contributes to the advancement of the nation and region's transportation workforce development, education, research, technology transfer, and outreach including K-12. Worth noting is the following:

- The 2014 PacTrans Regional Transportation conference was held successfully on October 17, 2014. Over 170 transportation professionals gathered at the University of Washington (UW) to attend this conference packed with the latest research findings and innovations accomplished by PacTrans researchers. Participants came from across the Pacific Northwest, representing transportation agencies, universities, and private companies from all four states in Region 10 (Alaska, Oregon, Idaho, and Washington). The purpose of this conference was to create opportunities for PacTrans researchers, government officers, and transportation practitioners to come together to share research results, identify research needs, facilitate technology transfers, network, and form potential collaborations. More details of this important event can be found online from the PacTrans Special Issue Newsletter (http://depts.washington.edu/pactrans/wp-content/uploads/2014/11/PacTrans_Conference_2014.pdf).
- Jointly sponsored by PacTrans and the UW student chapter of the Washington Institute of Transportation Engineers (ITE Washington), the Region 10 Student Conference was held on October 18, 2014. Transportation student representatives from all four states in Region 10 assembled at the UW and learned about new transportation research occurring in the Pacific Northwest and how to prepare for success in the professional world of transportation engineering. Wayne Kittelson, the Founding Principal of Kittelson & Associates and member of the PacTrans External Advisory Board (EAB), delivered the keynote speech on career opportunities in transportation engineering. Mark Hallenbeck, associate director of PacTrans and director of Washington State Transportation Center (TRAC) also attended this Region 10 Student Conference and delivered a talk on engineering communications.

The PacTrans Board of Directors (BOD) met at the University of Washington on September 3, 2014 to discuss center activities, research, and technology transfer. During the full-day meeting, the BOD covered a broad range of matters, including recounting the successes of the year thus far and establishing goals and strategies for upcoming endeavors. The BOD reviewed the programs of the PacTrans Region 10 Conference scheduled on October 17, 2014 and its student

conference on the following day, and anticipated another productive and popular event. Research topics and projects were also discussed in this meeting for the new PacTrans University Transportation Center (UTC) grant that focuses on safety.

- PacTrans hosted the Autumn Regional Transportation Seminar on November 5, 2014. Professor Michael Cassidy of UC Berkeley, director of the Region 9 University Transportation Center funded by US Department of Transportation, was the speaker. Dr. Michael Cassidy is Chancellor's Professor of Civil and Environmental Engineering at UC Berkeley, and Director of the University of California Center on Economic Competitiveness in Transportation. His lecture entitled "Lessons Learned from Spatiotemporal Studies of Freeway Carpool Lanes" attracted more than sixty participants on site and multiple remote participation sites through the webinar link. This PacTrans Regional Transportation Seminar is video recorded and can be accessed online at http://mediasite6.pce.uw.edu/Mediasite/Catalog/catalogs/PacTrans_Seminar_Nov5.
- PacTrans also sponsored several other university level transportation seminars. For example, Dr. Yafeng Yin, associate professor at the Department of Civil and Coastal Engineering and the director of Transportation Research Center, University of Florida, presented his talk, "Modeling and Analysis of Advanced Parking Management for Traffic Congestion Mitigation," at the UW on December 15, 2014. In this talk, Dr. Yin discussed how the proliferation of smart phones provides tremendous opportunity for addressing parking management. Over forty participants from local agencies, companies, and research institutes are attracted. Dr. Yin also serves as the editor in chief for a leading transportation technology research journal: Transportation Research Part C.
- PacTrans performed a leadership role in AutomotiveUI 2014, the 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, held in Seattle from September 17 through 19, 2014. Professor Linda Boyle, associate director in research for PacTrans, served as the conference chair. PacTrans was a gold level sponsor for this important transportation safety conference. As the premier forum for User Interface (UI) research in the automotive domain, the conference brought together approximately 220 researchers and practitioners interested in both the technical and the human aspects of in-vehicle user interfaces and applications. In total, there were eighteen countries from Australia, Europe, Asia, and North America represented at the conference, with fairly equal representation from academia and industry. The conference included workshops, lecture sessions, and interactive demonstrations.
- PacTrans continues its support for the University of Idaho's student teams which offer great training opportunities for students. For example, a spot on the Formula Hybrid Racing Team or the Clean Snowmobile Team means working with students and professors from multiple disciplines for a year or more. This sustained involvement means students become familiar not only with the technology they are working with, but also with the tenor of the industry, which benefits them greatly for career development.

- The U.S. Department of Transportation Secretary, Anthony Foxx, visited the University of Idaho in early October to meet with National Institute of Advanced Transportation Technology (NIATT) students and even tried out the Vandal Formula Hybrid Race Car, which won the 2014 National Formula Hybrid Competition.
- PacTrans was a non-financial co-sponsor for the ARTBA 2014 TransOvation Workshop. This was the fourth annual Dr. J. Don Brock TransOvation Workshop that was held November 17 – 19, 2014 at Microsoft Corporate Headquarters in Redmond, Washington. Transportation design and construction professionals gathered to hear from research institutes, private sector, and government thought leaders on the potential impact of big data and other technological and social changes on transportation infrastructure over the next 15 years. More than ten PacTrans researchers attended this workshop. Professor Yinhai Wang, director of PacTrans, shared PacTrans research on transportation big data at this TransOvation workshop.
- Tsinghua University Delegation visited PacTrans for possible collaborations on engineering research and education. This delegation was led by Professor Zhang Yi, vice provost in global affairs of Tsinghua University and visited the UW on September 11, 2014. They were welcomed by PacTrans, Microsoft leaders, and members of the UW community, including Professor Jeffrey Riedinger, Vice Provost for Global Affairs, and Brad Smith, executive vice president of Microsoft. The exchange event at PacTrans brought faculty and administrators from both universities together to discuss cutting edge research in intelligent transportation and smart cities.
- PacTrans continues its effort in enhancing collaborations with local transportation partners. For example, PacTrans welcomed officials from the Washington State Department of Transportation (WSDOT) Research Office to the UW on August 6, 2014 to build and strengthen the organizations' partnership. Such exchange occurs at least once a year for collaborations in research, workforce development, outreach, and technology transfer.
- A research facility funded in part by PacTrans and associated with the PacTrans project was developed by the Oregon State University (OSU) faculty. A ribbon cutting ceremony celebrated the new OSU-Benton County Green Stormwater Infrastructure Research (OGSIR) Facility on October 16 in Corvallis, Oregon. This three-celled stormwater research facility allows for field-scale experiments and testing on green infrastructure such as raingardens and bioswales.

- **What opportunities for training and professional development have the program provided?**

The vast majority of research projects involve graduate students, which also provide many opportunities to work with state and local transportation agencies. By involving students, PacTrans provide students an invaluable opportunity to develop skills they need to be successful in their future careers in academia, industry, and government. The intern program between PacTrans and WSDOT continued to offer great training opportunities for undergraduate students. PacTrans worked with regional industry (e.g. Transpo) and transportation agency partners (e.g. Seattle DOT) to initiate many new intern

positions for graduate students. Additionally, since the summer of 2013, PacTrans has sponsored a series of student academic activities like student conferences, travel to academic conferences, student team projects, student lectures, etc. The driving force behind this program is to provide students a variety of career development and educational opportunities to enhance their understanding and capability in transportation planning and engineering.

The student academic activities include:

- PacTrans invited seven outstanding transportation professionals to deliver talks to PacTrans students. These talks covered a variety of fields in transportation, from transportation safety to international trade and logistics. These events are very helpful for students to build up a comprehensive understanding of transportation and develop skills to address critical transportation issues in future practice.
- PacTrans offers intern opportunities for both graduate and undergraduate students to work in the PacTrans consortium university labs to gain hands on experience in transportation. For example, the PacTrans Smart Transportation Applications and Research Laboratory (STAR Lab) offered 6 student interns during the reporting period. One of these interns is Benjamin Wright, a senior student at the UW who started his intern position in the STAR Lab when he was a sophomore. He learned quickly and performed very well. He won the Mary Gates Fellowship twice because of his excellent research accomplishment at the STAR Lab.
- PacTrans keeps supporting student education and research activities. The UW awarded PacTrans fellowships to four outstanding new graduate students: Ryan Hughes, Michael Corwin, Kelly Fearon, and Jackson Lester. Additionally, travel funds were allocated to students for academic conferences. For example, Kristian Henrickson, a PhD student at the UW, was sponsored to attend the North American Travel Monitoring Exposition and Conference (NATMEC) 2014 in Chicago, June 29 – July 2. Kristian gave two podium presentations at NATMEC 2014, “Opportunistic GPS Location and MAC Address Sensing for Pedestrian Data Collection” and “Kinect-Based Pedestrian Detection for Crowded Scenes.” His presentations resulted from PacTrans sponsored research and were well received at the conference.
- PacTrans funded the Alaska Summer Research Academy (ASRA) Student Challenge, which involved designing and building a full-scale, multi-use trail bridge able to accommodate the width and load of a utility task vehicle (UTV). Students quickly learned collegiate-level principles of geometry, vector forces, and statics to design a truss using the method of joints to calculate the member tensile and compressive forces.
- PacTrans sponsored the 2014 Region 10 Student Conference on October 18, 2014. Students from Alaska, Idaho, Oregon, and Washington learned about new transportation research occurring in the Pacific Northwest, future career opportunities, communication skills and how to prepare for success in the professional world of transportation engineering.

- **How have the results been disseminated? If so, in what way/s?**

PacTrans has a strong outreach program to local and state transportation agencies and private partners in the region, through which PacTrans research outcomes are presented and demonstrated. Several outcomes of Region 10 UTC funded research projects have been showcased in invited talks, conference presentations, and archival publications. In addition to these conventional channels, PacTrans also promotes its research findings through social media (such as Twitter), its annual report, and quarterly newsletters. To facilitate technology transfer, the annual PacTrans Region 10 Transportation Conference serves as a platform for research exchange and provides valuable opportunities for researchers to communicate directly with practitioners on their research products. The 2014 PacTrans Region 10 Transportation Conference, held on the UW campus on October 17, 2014, was such a conference featured by poster presentations of all PacTrans funded research projects.

In summary, we participated and presented our research at the following events:

1. The 2014 North America Travel Monitoring and Exhibition Conference (NATMEC 2014). This conference was held in Chicago June 29 – July 1, 2014. More than 300 people attended this event. Three presentations resulting from PacTrans research were presented at this event.
2. The 2014 TransOvation Workshop. PacTrans was a non-financial co-sponsor for this event held November 17 – 19, 2014 at Microsoft Corporate Headquarters in Redmond, Washington. About 100 people attended this workshop. Dr. Yinhai Wang shared PacTrans research on big data and introduced other active PacTrans research projects at the workshop.
3. The AutomotiveUI 2014 Conference. This event was sponsored by PacTrans and led by Professor Linda Boyle, associate director of PacTrans. Professor Linda Boyle and her students shared PacTrans research findings on transportation safety, particularly human factor impacts to collision risks, at this conference held in Seattle from September 17 through 19, 2014.
4. Several international or domestic delegations visited PacTrans during the reporting period. For example, the Tennessee DOT Peer Exchange Team visited PacTrans on July 24, 2014 and a Big Data delegation from China Ministry of Transport exchanged research with the PacTrans STAR Lab on September 4, 2014. PacTrans researchers introduced their research in traffic sensing, system operations, and big data analytics to the visitors.
5. PacTrans researchers published 87 peer reviewed journal articles and 33 conference proceeding papers and made 37 invited talks and 57 presentations to disseminate research findings in this reporting period. Particularly, Professor Yinhai Wang delivered a keynote speech entitled “From Data Poor to Data Rich: New Challenges and Opportunities for Transportation Professionals” at the 10th China-Japan Joint Symposium on Transportation: Transportation in the Era of Big Data on July 25, 2014.

- **What do you plan to do during the next reporting period to accomplish the goals and objectives?**

PacTrans will keep following its implementation plan to ensure that all PacTrans funded research, education, and outreach activities move forward as scheduled. Specifically, the following events have been planned in approaching its goals.

- Regional transportation research workshop in spring 2015. This workshop will bring transportation agency and industry partners to the UW campus to talk about critical transportation research issues and regional research efforts in the Pacific Northwest.
- Leadership training workshop to PacTrans students. Marsha Anderson Bomar, previous president of Transportation and Development Institute (T&DI) in American Society of Civil Engineers (ASCE), has accepted our offer to come to deliver a training talk.
- PacTrans Reception at the 2015 Transportation Research Board (TRB) Annual Meeting. This is a traditional event for PacTrans consortium partners and friends to meet during the TRB conference. Michael Kyte Student of the Year will be identified and awarded during the reception event.
- PacTrans will continue to work with our technology transfer committee to identify research products with potential for technology transfer and intellectual property from completed research projects. A technology transfer grant will be launched to facilitate the process for promising research products.
- PacTrans will continue to enhance the PacTrans website to include additional information about our projects and research findings, and future research opportunities.
- PacTrans Regional Transportation Seminar series and other PacTrans sponsored seminar and conference events will continue to attract top level speakers to deliver cutting edge research and practical engineering solutions to our audience.
- Products from the PacTrans education research project will be evaluated for possible use potentially in transportation programs in Region 10 and possibly other regions.

2. Products (for the reporting period of July 1 – December 31, 2014)

| | PacTrans Total | UW Total | WSU | UI | OSU | UAF |
|--|-------------------|-------------|-----|----|-----|-----|
| Publications: Peer reviewed journal articles | 87 | 50 | 4 | 1 | 25 | 7 |
| Publications: Book chapter and other edited manuscripts | 6 | 6 | 0 | 0 | 0 | 0 |
| Conference Papers | 33 | 15 | 0 | 0 | 13 | 5 |
| Conference Presentations | 57 | 30 | 0 | 3 | 18 | 6 |
| Lectures/Seminars/Workshops/Invited Talks | 37 | 29 | 0 | 0 | 5 | 3 |
| Inventions, Patent Applications, and/or licenses | 2 | 0 | 1 | 0 | 0 | 1 |
| Website | 5 | 2 | 0 | 2 | 0 | 1 |
| Other products: Data or Database, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments, or equipment | 9 | 3 | 0 | 0 | 1 | 5 |

- **Examples of peer reviewed journal articles**

Xiao, F., Chen, G. S. and Hulse, J. L., 2014, "Experimental Investigation of a Bridge under Traffic Loadings, *Advanced Materials Research*," **875-877**, pp. 1989-1993.

Xiao, F., Hulse, J. L., and Chen, G. S., 2016, "Structural Health Monitoring of the Klehini River Bridge, *Journal of Vibration Engineering and Technologies*," **4(4)**.

Xiao, F., Chen, G. S. and Hulse, J. L., Sielbach, D., "Ambient Loading & Modal Parameters for Chulitna River Bridge, *ASCE Journal of Bridge Engineering*" (In Submission).

Xiao, F., Hulse, J. L., and Cheng, G. S., "Multi-direction Bridge Model Updating using Static and Dynamic Measurement" (In Edit).

Chen, G. S., Xiao, F., and Hulse, J. L., "Characterization of Nonlinear Dynamics for an Alaskan Highway Bridge using Chaos Dynamical System Invariants" (In Edit).

Chen, G. S., Xiao, F., Huffman, J., and Hulse, J. L., "Detection of Soil-Abutment Interaction by Identifying Dynamical Signature of Bridge Response Using Vehicle Excitation on Road" (In Edit).

Hoisington David, Hoffman Jeff, and Hamel Scott., 2014, “Measured Anchor Rod Tightening of High-Mast Light Poles in Alaska,” *Transportation Research Record: Journal of the Transportation Research Board*, **2431**, pp. 67-72.

Belz, N.P., Aultman-Hall, L., Lee, B.H.Y., and Gårder, P.E., 2014, “An Event-Based Framework for Non-Compliant Driver Behavior at Single-Lane Roundabouts”, *Transportation Research Record: Journal of the Transportation Research Board*, **2402**, pp. 38-46.

Bham, G. H., Leu, C. C., Mathur, D. R., and Vallati, M., 2014, “Effective Design Patterns for Vehicle Mounted Attenuators,” *Accident Reconstruction Journal*, **25**(4), pp. 43-50, 63.

Hurwitz, D., Miller, E., Jannat, M., Boyle, L., Brown, S., Abdel-Rahim, A., and Wang, H. (2nd round review 10/18/2014) “Improving Teenage Driver Perceptions Regarding the Impact of Distracted Driving in the Pacific Northwest,” *Journal of Transportation Safety & Security*.

Morales, M., Isgor O.B., Ghods, P., and Salehi, M. (in preparation), “Experimental investigation on the parameters affecting surface resistivity measurements on reinforced concrete slabs,” to be submitted to the *Journal of Construction and Building Materials*.

Babbar-Sebens, M., Mukhopadhyay, S. , Singh, V.B., and Piemonti, A.D., “A web-based software for participatory optimization of conservation practices in watersheds,” *Environmental Modelling and Software* (in review).

Javaheri, A., and Babbar-Sebens, M., 2014, “On comparison of peak flow reductions, flood inundation maps, and velocity maps in evaluating effects of restored wetlands on channel flooding,” *Ecological Engineering*, **73**, pp. 132–145.

Neill, J., Hurwitz, D., & Olsen, M., (2nd round review submitted 11/14/2014), “Alternative Information Signs in Oregon,” *ASCE: Journal of Transportation Engineering*.

- **Example of book chapters and other edited manuscripts**

Abstract accepted for the Annual Chinese Overseas Transportation Association Conference, full paper due 12/25/2014

- **Examples of conference papers**

Hulsey, J. L., Xiao, F., and Chen, G. S., 2013, “Structural Health Monitoring of An Alaska Bridge,” 6th International Conference on Structural Health Monitoring of Intelligent Infrastructure, Dec.9, Hong Kong, China.

Hulsey, J. L., Xiao, F., and Chen, G. S., 2013, “Structural Health Monitoring System Optimization For A Bridge,” 6th International Conference on Structural Health Monitoring of Intelligent Infrastructure, Dec.9, Hong Kong, China.

Hulsey, J. L., Dolan, J. D., Xiao, F., 2013, "Structural Health Monitoring of Chulitna River Bridge," PacTrans Conference, Oct. 18, University of Washington.

Mukhopadhyay, S., Singh, V.B., Piemonti, A.D., and Babbar-Sebens, M., 2014, "User Modeling with Limited Data: Application to Stakeholder-driven Watershed Design," Proceedings of the IEEE Systems, Man, and Cybernetics (SMC) Conference, Oct. 5-8, San Diego, USA.

Hyun Woo Lee, poster presentation at the OSU's 2014 Graduate Research Exposition

Romney, K. T., Barbosa, A. R., and Mason, H. B. 2014, "Developing a soil-bridge interaction model for studying the effects of long-duration earthquake motions," Tenth U.S. National Conference on Earthquake Engineering, Anchorage, Alaska.

Carey, T., Mason, H. B., Barbosa, A. R., and Scott, M. H., 2014, "Modeling framework for soil-bridge system response during sequential earthquake and tsunami loading," Tenth U.S. National Conference on Earthquake Engineering, Anchorage, Alaska.

- **Examples of conference presentations**

David S. Hurwitz. Poster Presentations at the PacTrans Annual Meeting in 2013 and 2014

Morales, M., Isgor O.B., Ghods, P., and Salehi, M., 2014, "Experimental and numerical investigation of the influence of cracks and corrosion on electrical resistivity measurements using a four-point Wenner probe". In Research in Progress. 2014 ACI Fall Conference, Washington, DC. (October 26-30, 2014).

Morales, M., Isgor O.B., Ghods, P., and Salehi, M., 2014, "Experimental and numerical investigation of the influence of cracks on electrical resistivity measurements using four-point Wenner probe," In Sustainable and Resilient Systems. 2014 EMI Conference, Hamilton, Ontario, Canada. (August 5-8, 2014).

Babbar-Sebens, M., Piemonti, A.D., Mukhopadhyay, S., and Singh, V.B., 2014, "User Modeling and Personalized Optimization for Stakeholder-driven Watershed Design," In: HIC 2014 – 11th International Conference on Hydroinformatics, Aug. 17 – 21, New York, NY.

Javaheri, A., and Babbar-Sebens, M., 2014, "Remote sensing data assimilation in water quality numerical model of Eagle Creek Reservoir using ensemble Kalman filter method." In: HIC 2014 – 11th International Conference on Hydroinformatics, Aug. 17 – 21, New York, NY.

Poster Presentation at the Oregon Transportation Summit, 2014 and the PacTrans Annual Meeting, 2014.

Romney, K. T., and Barbosa, A. R., 2014, "Developing a soil-bridge interaction model for studying the effects of long-duration earthquake motions," Tenth National Conference on Earthquake Engineering, Jul. 22, Anchorage, Alaska.

Carey, T. J., Barbosa, A. R., Mason, B., and Scott, M. H., 2014, "Modeling framework for soil-bridge system response during sequential earthquake and tsunami loading," Tenth National Conference on Earthquake Engineering, Jul. 22, Anchorage, Alaska.

Liu, J., 2014, "Evaluation of Pavement Preservation Treatments in Cold Regions," 17th Annual National Native Tribal Transportation Conference, September, Anchorage, AK.

- **Example of lectures/seminars/workshops/invited talks**

Morales, M., Isgor, O.B., Ghods, P., and Salehi, M., 2014, "Experimental and numerical investigation of the influence of cracks on electrical resistivity measurements of reinforced concrete slabs using four-point Wenner probe." In The Corvallis Workshops Poster Session, 2014 Corvallis Workshops, July 15-18, Corvallis, OR.

Romney, K. T., 2013, "Soil-bridge interaction during long-duration earthquake motions," MS thesis, Oregon State University, Corvallis, OR.

Carey, T., 2014, "Multi-hazard framework and analysis of soil-bridge systems: Long duration earthquake and tsunami loading," MS thesis, Oregon State University, Corvallis, OR.

Keith Cunningham, PacTrans poster October 2014.

- **Examples of technologies or techniques**

Barbosa, A. R., Mason, H. B., and Romney, K. T. (2014). SSI Bridge: Soil-Bridge Interaction during Long-Duration Earthquake Motions. Final Project Report. Pacific Northwest Transportation Consortium (PacTrans), University of Washington, Seattle, WA.

- **Scheduled known academic talks for upcoming reporting period (Jan. 1 – June 30, 2015)**

1. Yin Hai Wang. International Conference on Urban Traffic Safety. "Traffic Data Sensing Technologies." April 30, 2015.

2. Yin Hai Wang. PacTrans Research on Transportation Safety. Joint meeting of ITE Washington and International Municipal Signal Association. Spring 2015.

3. Participant and Collaborating Organizations: Who has been involved?

- **What individuals have worked on the program?**

PacTrans Director, Yin Hai Wang, Ph.D., Professor of Civil and Environmental Engineering at the University of Washington (UW), devotes 50 percent of his time directing PacTrans. Dr. Wang has overall responsibility for program management, oversight of PacTrans operations, including the Research Committee, the Education and Workforce Development Committee, and the Outreach and Technology Transfer Committee, and Student Leadership Council. He is the regional and national leadership for PacTrans, and the contact person for management relationships with USDOT Research and Innovative Administration (RITA) and other USDOT organizations.

PacTrans Associate Director in Research, Linda Ng Boyle, Ph.D., Professor with joint appointments in Industrial and Systems Engineering and Civil and Environmental Engineering at the UW spends 10 percent of her time managing the research program for PacTrans and coordinates the research collaboration across the five partner institutions.

PacTrans Associate Director in Education and Workforce Development, Anne Vernez-Moudon, Dr. es SC, Professor of Architecture, Landscape Architecture, and Urban Design and Planning, Adjunct Professor of Epidemiology and in Civil and Environmental Engineering, devotes 10 percent of her time leading the Education and Workforce Development Committee. She is involved in curriculum changes, professional training program development, and educational enhancements among the partner institutions.

PacTrans Associate Director in Outreach, Mark Hallenbeck is also the Director of the Washington State Transportation Center (TRAC) office located at the UW. Mr. Hallenbeck works closely with Associate Director Anne Vernez-Moudon in organizing student seminars, internships and fellowship programs.

PacTrans Associate Director in Oregon State University (OSU), Chris Bell, Ph.D., Professor of Civil and Construction Engineering at OSU, devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within OSU. He coordinates all results and outcomes with the UW on a regular basis.

PacTrans Associate Director in the University of Alaska Fairbanks (UAF), Billy Connor, Director of the Alaska University Transportation Center (AUTC), devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within UAF. He coordinates all results and outcomes with the UW on a regular basis.

PacTrans Associate Director in University of Idaho (UI), Ahmed Abdel-Rahim, Ph.D., Associate Professor of Civil Engineering at UI, devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within UI. He coordinates all results and outcomes with the UW on a regular basis. Ahmed came aboard on March 2014, replacing Dr. Karen Den Braven who retired in February 2014.

PacTrans Associate Director in Washington State University (WSU), Ken Casavant, Ph.D., Professor and Transportation Economist in the School of Economic Sciences at Washington State University (WSU) and Director of WSU's Freight Policy Transportation Institute, devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within WSU. He coordinates all results and outcomes with the UW on a regular basis.

Maria Bayya devotes 100 percent of her time Assistant Director with responsibilities of grant management, project management and oversight of the PacTrans operations team.

The Student Leadership Council, composed of graduate students at all Consortium partner universities, is an active part of the PacTrans management structure. The Student Leadership Council facilitates student and center communications and plans their own activities. For example, one important student event on the PacTrans schedule is the Region 10 Student Conference, held at the UW campus on October 18, 2014. Sponsors were leaders of the four UTCs in this region – PacTrans, the National Institution for Transportation and Communities (NITC), Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC), and Transportation for Livability by Integrating Vehicles and the Environment (TranLIVE).

Additionally, PacTrans has 26 fulltime faculty at the UW engaged in transportation research. Our consortium partners (OSU, UI, WSU, UAF) have 39 fulltime faculty directly involved in PacTrans research.

- **What other organizations have been involved as partners?**

- The state transportation agencies in Alaska, Idaho, Oregon, and Washington have all been extensively involved in PacTrans in terms of research, outreach, and technology transfer activities. Their research office directors are members of our PacTrans External Advisory Board (EAB), which provides strategic oversight to the PacTrans Board of Directors. In addition to the state DOTs, many other public transportation agencies and private companies are also actively involved in PacTrans activities.
- The PacTrans EAB provides strategic guidance to the PacTrans Board of Directors. In addition to state DOT members on the PacTrans EAB, membership includes a representative from Toyota Corporate, Port of Portland, the Puget Sound Regional Council (PSRC), as well as a representative from Idaho industry, Western Trailers.

- PacTrans also collaborates with Portland State University's UTC (NITC), University of Alaska Fairbanks' Center for Environmentally Sustainable Transportation in Cold Climates (CESTICC), and University of Idaho's Transportation for Livability by Integrating Vehicles and the Environment (TranLIVE) on various Region 10 events.

4. Impact

- **What is the impact on the development of the principal discipline(s) of the program?**

All the research projects funded in the Fiscal Year (FY) 2012-2013 have been completed. These projects address all the five strategic directions of USDOT. Specific impacts on the development of the principal disciplines of our program are as follows:

- (1) Project 2012-M-0001: Inspection, Assessment, Monitoring, and Renewal Strategies for Structures on Critical Lifeline Corridors (2012-14)

The Pacific Northwest (PNW) faces unique combinations of environmental hazards, including the strong potential for seismic events from the Cascadia Subduction Zone (CSZ). This research tries to keep critical corridors operational during and after a seismic event on the CSZ to minimize loss of life and economic impact after the quake in the State.

This research performs inspections of bridges on critical corridors. In addition, the research identifies methods to assess the health of bridge structure and innovative methods for repairing, rehabilitating, or replacing bridges on critical corridors. The outcome of the research provides State Highway Administrations (SHAs) with efficient methods to inspect, assess, repair, rehabilitate, or replace these critical structures.

- (2) Project 2012-M-0002: A Platform for Proactive Risk-Based Slope Asset Management (2012-14)

The objective of this project is to develop a platform that facilitates an objective programming of DOT resources for rock-slope assets within highway corridors. This platform takes the form of an administrative tool that enables highway owners to make informed decisions on how best to program resources related to rock-slope inspection and remediation.

This project helps qualify/quantify the level of risk a rock-slope poses to the highway corridor customers (users) based on the current condition and importance metrics of the corridor. Findings of this project can be used for slope asset management and theory development for roadway corridors.

- (3) Project 2012-M-0003: An Innovative Survey Design to Understand Sustainable Travel Behaviors (2012-14)

An innovative survey is being undertaken with rolling samples to address a major fiscal challenge faced by many MPOs. Faced with a small but continuous budget, MPOs are increasingly unable to continue the current survey practice: conducting a large survey every 10 years. A rolling sample design also has other benefits over the current practice. Yet, for its implementation in household travel surveys, many questions exist. Some are technical issues, while others are cost and procedural-related. The primary purpose of this project is to understand these issues and provide recommendations for a future household travel survey with rolling samples.

The research helps transportation planners and analysts to proactively reposition their service in light of the changing budgetary environment by developing a new approach to travel surveys based on small samples but continuous enrollment. This new approach is also more consistent in data collection methods used by the US Census Bureau. The research enables researchers to gain a much better understanding of the potential of designing a new methodology for empirical examinations of the effects of built environments on transportation outcomes based on data collected from continuous enrollment.

(4) Project 2012-M-0004: Developing a Performance Measurement Approach to Benefit/Cost Freight Project Prioritization (2012-14)

This project will investigate the use of performance data for the emerging freight project prioritization methodologies, primarily through the investigation of minimum performance standards and ongoing performance evaluation to develop a prioritization methodology that recognizes the impact of investments on overall freight system performance.

The project results in a cost-benefit analysis framework tool, supported by truck travel data collected from GPS devices, designed to be used by public transportation agencies in the Pacific Northwest. The project also results in a final recommendation for a benefit/cost methodology and a set of recommendations for how WSDOT can integrate performance management (primarily GPS data based) with its freight project prioritization process (including benefit/cost analysis).

(5) Project 2012-M-0005: Performance Monitoring for Safe and Livable Communities: Fusing Data to Improve Arterial Operations for All Users (2012-14)

Safe travel and livable communities require data that can characterize all modes, not just motorized vehicles. The problem many transportation professionals face is measuring performance and correcting poor performance to meet community goals. This project integrates data from multiple sources for a more complete understanding of how to improve arterial traffic safety and how arterial systems serve each mode and steps that professionals should take to improve service.

This project achieves the goals of safety and efficiency to attain greater community livability. Specifically, this project develops improved performance measurement for a diverse set of transportation modes, and develops processes/tools needed to estimate performance measures, and develops a foundation for researching secure control feedback for mode, safety, weather, and traffic condition sensitive response.

- (6) Project 2012-M-0006: Digital Dissemination Platform of Transportation Engineering Educational Materials Founded in Adoption Research (2012-14)

This project aims to answer some important questions about curriculum through an investigation of how faculty adopt curriculum when developing a new course or revising an existing course and using this knowledge to develop an architecture and sustainable plan for a web-based dissemination venue.

This report provides insight into existing practices of individuals developing introductory courses in transportation engineering. The results of this study suggest tangible and direct means of addressing potential users' perceptions about the repository and the materials included within it, such as managing the size of materials provided onsite and providing various ways of accessing the materials.

- (7) Project 2012-M-0007: Educating Teenage Drivers in the Pacific Northwest Regarding the Dangers of Distracted Driving (2012-14)

The goal of the study is to examine driver distraction among teenagers including what tasks they consider to be distracting as compared to their level of engagement in these same distracting tasks. All five partners in PacTrans are involved in this project. Each consortium university also outreached local high schools by delivering seminar talks to high school students in educating them the danger of distracted driving. Inputs were also solicited from teenage drivers through face-to-face interactions as well as surveys.

Though interactions with high school students, valuable data were collected in understanding teenage drivers' driving habits and perception of distractions during driving. These findings are important for teenage driver education and were summarized in a short video available online at https://www.youtube.com/watch?v=bM_iNEyVxcg&feature=youtu.be.

- **What is the impact on other disciplines?**

In addition to the intellectual merits in the transportation field, PacTrans research represented by the seven multi-institutional projects is also expected to generate impact on other disciplines. For example, the outreach project (Project 2012-M-0007: Educating Teenage Drivers in the Pacific Northwest Regarding the Dangers of Distracted Driving) helps understand factors causing teenage driver distraction while driving and develop solutions to reduce distracted driving. Findings of this project definitely

contributes to teenage drivers' safety education and regulations. Another example is the PacTrans educational research project (Project 2012-M-0006: Digital Dissemination Platform of Transportation Engineering Educational Materials Founded in Adoption Research). Although the target of this project is to investigate how transportation faculty adopt curriculum when developing a new course or revising an existing course and use this knowledge to develop an architecture and sustainable plan for a web-based dissemination venue, the same framework can be easily transformed to other disciplines.

- **What is the impact on transportation workforce development?**

PacTrans continues its dedication to transportation workforce development. In addition to the award-winning intern program with WSDOT and several other new intern programs recently established, PacTrans is making great efforts to merge the gap between practice and university education. One such effort is to sponsor training workshops to address practical issues on demand. Many such events were sponsored by PacTrans, including the 2014 PacTrans Regional Transportation Conference, and the University of Idaho (UI) Vandal Formula Hybrid Racing Team.

After the UI team won a number of the 2014 National Formula Hybrid Competition's top awards, team members were asked to leave resumes with GM representatives and were invited by the Chrysler team for a site visit and job interviews. Over the past five years, the team has had seven students go on to work in the automobile industry. The University of Idaho's Clean Snowmobile Team has also seen three members go on to work in the automotive industry and ten work in the power sports industry in the last five years. One of the reasons that the UI's National Institute for Advanced Transportation Technology (NIATT) team initiatives are such impressive and effective workforce development and career building tools is that these aren't simply a few weeks spent working on a project for a professor. A spot on the Formula Hybrid Racing Team or the Clean Snowmobile Team means working with students and professors from multiple disciplines for a year or more. This sustained involvement means students become familiar not only with the technology they are working with, but also with the tenor of the industry. Andrew Hooper, MS in Mechanical Engineering '13, was with UI's Clean Snowmobile Team for five years. During an interview following his team's win in 2013, Hooper, now a project engineer for Polaris, stated that working on the team is a "very big career-opportunity maker for a student."

- **What is the impact on physical, institutional, and information resources at the university or other partner institutions?**

PacTrans has funded seven regional projects and 15 small projects in FY 2012-2013 and another seven regional projects and 25 small projects in FY 2013-2014. The FY 2012-2013 projects have been completed and produced many useful research findings. They will definitely add new physical, institutional, and information resources and facilitate cross sharing of existing resources among consortium partners. The short video product (https://www.youtube.com/watch?v=bM_iNEyVxcg&feature=youtu.be) resulted from Project 2012-M-

0007: Educating Teenage Drivers in the Pacific Northwest Regarding the Dangers of Distracted Driving is a great example.

Research laboratories of PacTrans consortium partners working on PacTrans projects added new research equipment, software tools, and other academic resources as part of their research efforts. For example, the UW STAR Lab shared its traffic sensors with researchers at the University of Idaho for a multi-institutional research project (Project 2012-M-0005: Performance Monitoring for Safe and Livable Communities: Fusing Data to Improve Arterial Operations for All Users). A variety of datasets were collected for analyzing pedestrian movements and route choice research. Data collected through these research projects and publications of the findings will result in new resources available for public access. The resources made available through PacTrans research can also attract new research grants.

- **What is the impact on technology transfer?**

PacTrans emphasizes technology transfer and involves relevant parties early in those funded projects with a technology development component. Its regional transportation conference in October 2014 offered a great platform for researchers and practitioners to talk about potential technologies for transfer. Also, the PacTrans STAR Lab maintains the state of the practice hardware currently utilized by WSDOT and other local transportation agencies. These hardware and software applications utilized in UW transportation courses and research are helpful for researchers to target the right problems for technology development.

In the PacTrans BOD meeting on September 3, 2014, a decision was made to require a deliverable for technology transfer in every PacTrans funded research project. Such a deliverable could be a video clip, a presentation file, or a website. The classical research report cannot satisfy this requirement. Also, PacTrans will allocate funding to facilitate technology transfer for promising products developed in the projects recently completed.

- **What is the impact on society beyond science and technology?**

The 2013 Report Card for America's Infrastructure produced by American Society of Civil Engineers gave a D for national road infrastructure rating. This implies that America's roadway system is in a "poor" situation due to insufficient investments. Given the importance of road for logistics, commuting, manufacturing, emergency response, etc., ensuring roadway safety and operability under the current budget condition is crucial for our society. All the PacTrans funded research projects contributed directly or indirectly to this important goal of transportation engineers.

Also, PacTrans' activities address a variety of safety issues for many transportation modes, including cars, bicycles, and pedestrians. PacTrans researchers actively participated in various meetings and conferences to disseminate knowledge on traffic and safety issues. Because transportation is related to everyone's daily life, our research certainly adds benefit to everyone's life. Through regular open house and other domestic or international exchange events, PacTrans Research Laboratory has received

thousands of visitors. In addition to showcasing PacTrans research products, researchers also took the opportunity to educate the general public for the correct behaviors to ensure transportation safety, sustainability, and mobility.

5. Changes/Problems

None.

6. Special Reporting Requirements

None.